Non destructive method for early detection of dark,firm,dry meat.

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Introduction.

Usually the ultimate-pH-value in unstimulated beef is determined by measuring the pH in the Longissimus muscle 48 hours post-mortem and after 24 hours in stimulated beef. This is carried out routinely in the largest meat distribution center in Norway. When having stimulated beef-,mutton- or lamb carcasses electrically, the ultimate-pH will be reached even before 24 hours. In the literature it is found that the Longissimus muscle is the muscle on the beef carcass which is most suitable for determining if the carcass is DFD or not.

Braathen (1983) has described a method by which a small piece of the Longissimus muscle is exised from the carcass immediately after dehiding and stimulated separately by low voltage electric pulses. The pH of the excised sample is measured after stimulation. When removing the small piece of meat for sampling, as few as possible of the muscle fibers should be cut off. If not,cold shortening will give a long "hole" in the muscle. Vada-Kovács (1981) has published a method using calcium ions for determining very early the ultimate-pH and another method is based upon freezing and thawing.

When combining the method of Vada-Kovács' and Braathen's "exiced sample method",one might be stimulating electrically the ground "hot" meat sample diluted in a calcium ion solution. This may give a fast decrease of the pH-value down to the "final pH". By such a destructive method very expensive parts of the carcass might be reduced in value.

Materials and methods.

The uniqueness of the following is that electric stimulation is applied only on a small restricted part of the Longissimus muscle, and the rest of the carcass is not affected by the electric pulses.The Longissimus muscle is innervated by multiple nerves covering relatively short sections along the whole muscle.

A special low voltage stimulator together with a plastic electrode holder was constructed.Almost the same type of low voltage electric stimulator is used daily in about fifty slaughter plants in Norway for stimulating whole carcasses. The stimulator is made by the company Scancontrol, Drammensveien 889, 1370 Asker, Norway.The voltage may be regulated from 90 volt peaks down to 0 volt peak. The stimulation frequency is 12,5 herz (Swatland 1977). The height of the pulses of the stimulating voltage may be varied.

As soon as the hide is removed,the two electrodes are "plugged" into the Longissimus muscle,and the electric stimulation is carried out for approximately one minute. The time may be adjusted by a built-in timer. Longer stimulation time might be used.

The two special electrodes on the plastic handle are placed approximately ten centimeters apart. The polyethylene handle together with the electrodes,is sterilized in a water bath at a temperature of minimum 82°C before use and between each carcass. The electrodes conduct the stimulating voltage into the deep parts of the Longissimus muscle section as well as to the surface of it.

As the negative electrode is "grounded" to the slaughterline rail it should be put into the muscle nearer the hind leg than the positive electrode. Thereby the electrodes provide a more effective stimulation.The operators removing the offals from the carcasses did feel disturbing pulsating electric voltage. relatively few carcasses, the electrode made from stainless steel,the anode,was covered with a black insulating layer. This layer had to be removed in order to obtain better conductivity for greater effectiveness.

In the largest slaughter plant in Norway the beef carcasses are dehided within 10 minutes post-mortem and pass the scale in halves already 13 minutes post-mortem. When passing the scale the carcasses are graded and the pH in the stimulated part of the Longissimus muscle is measured. Those carcasses having pH-values 6,0 and higher are not used for vacuum packaging and other purposes which we in Norway have found to require meat having a lower ultimate-pH than 6,0.

Results and discussion.

When testing the equipment,some of the carcasses were split before stimulation of a section of the Longissimus muscle on one carcass half. The pH-values were measured in the corresponding sections of the two carcass halves before and after stimulation.

pH-values 30 minutes post mortem.

From the curves on the diagram is seen that there is a great difference in pH between stimulated and non-stimulated Longissimus muscles. But there are almost no differences in their pH-values 24 hours after slaughter.

Interesting is that there is,perhaps in contrary to what might be expected, an extra fast pH-drop in the DFD-carcasses. The explanation is that the Ca-induced pH-drop is fast in all stress meat, in PSE as well as DFD. (Hamm,1984).

A very small increase in the pH-values of the DFD-carcass is seen at 4 and 24 hours post-mortem. This increase might most probably be explained by the lower degree of dissociation of lactate at lower temperatures. (Honikel 1984).

We have such low temperatures after chilling of the carcasses. The pH of a DFD-carcass which will get an ultimate-pH-value of for instance 6,0, will not at any time after an electric stimulation carried out according to this method,be below 6,0. This is a basic fact upon which this method is developed.

Some of the carcasses used for these tests were also stimulated as routinely for 32 seconds immediately after bleeding,in order to prevent cold shortening,with almost the same type of Scancontrol apparatus. When passing the scale 100% of the "twice stimulated" Longissimus muscle sections,in contrast to the other parts of the carcasses already had a pH below 6,0.

The stimulation of the Longissimus sections lasted in that test 40 seconds. We found in that part of the tests no DFD-carcasses. The pH-values of these carcasses are not shown in the diagrams.

By using longer stimulation periods, 2-5 minutes, the pH drop during this "local" stimulation might be even greater. Heat might perhaps develop. Temperature measurements were not carried out. Heat development might be ommited by using short intervals of,for instance 30 seconds,between the stimulation periods.

The speed of the slaughterline might have to be reduced if the stimulation should be carried out only when the dehided carcasses are not being worked on by the operators. The operators might use insulating rubber gloves in order to not need to work directly into contact with the irritating stimulating voltage.

The pulses are felt if the special Scancontrol insulation system is not used or if no special precautions are taken.

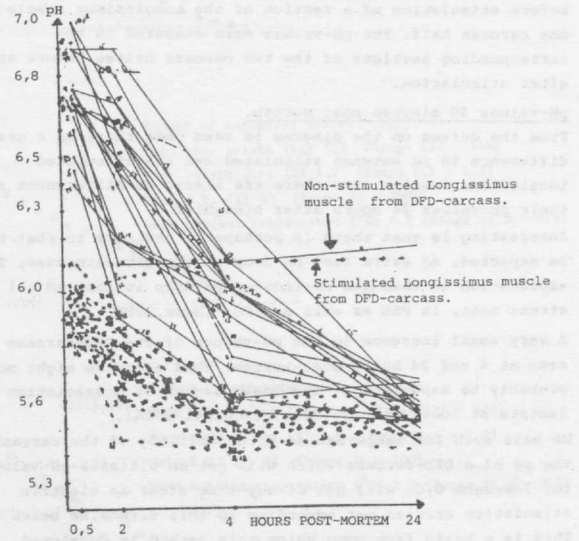
It was of interest to determine if the "local" stimulation affected sections of the opposite Longissimus muscle or other muscles in the carcasses, but no effect was found.

As mentioned, in one of the biggest slaugherhouses in Norway,the time from stunning of beef animals with a captive bolt,until the split carcasses pass the scale,is only 13 minutes.

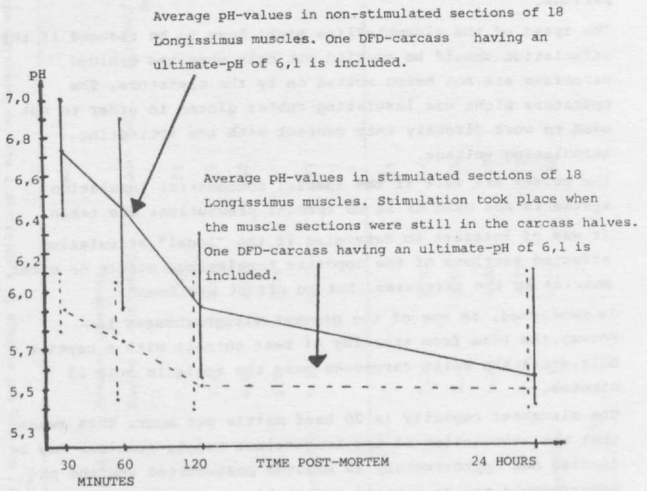
The slaughter capacity is 20 beef cattle per hour. This means that the stimulation of the Longissimus muscle sections may be carried out approximately 10 minutes post-mortem and the pH-measurements may be carried out 11-12 minutes post-mortem. At the same moment it is known if the carcass originate from a long time stressed animals.

When hot-boning is carried out,it is not desireable to stimulate electrically the whole carcass when the high pre-rigor water-binding and fat emulsifying capacity of the meat trimmings shall be taken advantage of. An effective

pH- VALUES IN LONGISSIMUS MUSCLES IN 18 CARCASSES.
DOTTED LINES SHOW THE pH-VALUES OF STIMULATED AND
STRAIGHT LINES THE pH-VALUES OF NON-STIMULATED MUSCLES.



AVERAGE pH-VALUES IN STIMULATED AND
NON-STIMULATED LONGISSIMUS MUSCLES.



electric stimulation is found to be reducing these capacities (Puolanne,1983 Brazel,1983).

The hot-boned meat cuts might be conditioned by delayed chilling in order to prevent cold toughening and to increase the tenderness. These two things may also be achieved by accelerated conditioning using an apparatus already developed for electrical stimulation of hot boned meat cuts.(Braathen, 1980).

The most effective method is to stimulate whole carcasses within a short time post-mortem when using low voltage. It has been reported however that electric stimulation still may be effective through the nervous system of the whole carcass until 32 seconds post-mortem. But when only a section of a muscle is stimulated by low voltage, the voltage calculated as volts per centimeter of muscle is high so the effect is good.

For determining if reindeer carcasses are going to produce DFD-meat this method might perhaps be useful. In Finland it is found a high incidence of DFD-quality in reindeer meat especially in the late winter months (Petaja,1983).

On the contrary it is found (Korbi and Braathen 1984) a very low incidense of DFD in reindeer meat from animals slaughtered in the Kautokeino slaughterhouse in Northern Norway.

One of the advantages of the method is that it may be decided very early if the carcasses are going to be aged. As reported the tenderness in DFD-meat is relatively good in contrary to the taste. Also the water binding capacity is high so DFD-meat should be used for manufacturing of cooked sausage.

The most important is certainly to handle our slaughter animals so humanely that no dark,firm,dry meat (DFD) is developed. The research on methods for reducing the incidence of stress meat should be paid more attention to by meat researchers than to methods for detecting this type of meat in carcasses (Grandin 1980). Also methods for prevention of the occurence of stress induced meat qualities are more important than methods which are aimed towards reducing the problems we realize with already developed stress meat.

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